

Summary: Issues and Open Questions

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- **Magnetism & Superconductivity:**
 - Microscopic co-existence vs phase separation
 - Excitations in the coexistence region

- **Quantum Criticality**

- Types of QCPs (“good guys, bad guys”)
- Nature of quasiparticles; dynamical scaling
- Fermi surface evolution
- Nearby phases (nature of magnetism, spin liquids, global phase diagram)
- Multiple tuning parameters (field vs pressure, frustration, dimensionality, ...)

- **Beyond AF quantum criticality**
 - Mixed valency
 - Existence proof of mixed-valent qcp?
 - “good guys” and “bad guys”?
 - Ferromagnetic quantum criticality
 - Can there ever be a ferromagnetic QCP?
 - Does Hertz/Millis/Moriya work for double-layer ruthenates?
 - Re-doped URu₂Si₂
 - YbNi₄P₂ (C. Krellner et al, NJP 2011)

- **Non-Fermi liquids/Supercond.**
 - Are most due to quantum criticality?
 - Dilute limit (single impurity or proximity to spin glass)
 - Lattice systems: Proximity -- how many ways? (Magnetism, Quadrupolar, Mixed valence, Multichannel)
 - Can both “good guys” and “bad guys” (SDW and local Kondo breakdown) superconduct?
 - UBe13, NpPd5Al2

- **Development of Kondo coherence**
 - Knight shift-susceptibility relationship
 - STM & Photoemission: signatures of Kondo onset
 - High energy signatures of Kondo and RKKY

- **Hidden order**

- Gaps; hybridization, hidden symmetry breaking
...
- Is superconductivity in URu₂Si₂ due to HO or due to proximity to magnetism?
- Are there analogues in d-electron systems?

- **Kondo insulators**

- Nature of gaps
- Phase transitions (Kondo breakdown?)
- Spin-orbit physics; topology
- Connection w/ spin-orbit physics in 5d systems?

- **d-f connection**

- Spin fluctuations vs Mott localization-delocalization
- Spin resonance/gap in superconducting state
- Zone-boundary high energy spin excitations

- **New methods**

- AdS/CMT

- Laser ARPES, ...

“There is no better, there is no more open door by which you can enter into the study of correlated electrons than by considering the physical phenomena of heavy fermions”

Andy Schofield/Michael Faraday